flows down over the copper plate at the bottom, and in less than five minutes the cell is in full work.

We have at present forty cells such as I have just described. The average resistance of one cell is 0·19 of an Ohm. The electro-motive force of a Daniell's cell is 1·07 Volts.

The second form of cell is of the following construction. A shallow wooden tray, square, and with slightly slanting sides, is lined with sheet lead; and this, after being electrotyped with copper, forms both the containing vessel for the liquids and the copper plate of the cell. Copper trays were used at first, but they were soon eaten through by the solution. The lead is not attacked at all. The length of a side of the lead tray is 21in., and its depth is 3¾in. In each corner is set a small block of wood 1½in. high. The zinc plate, which is like a square gridiron, rests at its corners on these blocks. The zinc has parchment paper tied round its lower surface and sides. The cell is filled up with saturated solution of sulphate of zinc, and crystals of sulphate of copper are dropped in when required round the edges outside the parchment paper. For connecting these cells together in series, the lead lining is carried over the wooden tray at the corners and down the outside to the under surface of the bottom of it. Here it is soldered to a small square of thick sheet tin. The cells are piled up one on the top of the other, the tin plates of the second cell resting on the zinc of the first, and so on. The tin connections—a suggestion of Mr. Varley—are most excellent. Two of these cells are shown in section Fig. 5. The resistance of each of these cells is on an average 0·19 of an Ohm. They are now used at all the telegraph stations where Sir William Thomson's siphon recorder is employed.

In using these batteries in a laboratory where they are not perpetually at work, the best way of managing them may possibly be not to charge them with sulphate of copper except when they are about to be used, and only to put in as much as will do the work required. To calculate the quantity is easy; and any small excess might be worked off through a low resistance. We have been keeping them at work almost night and day. They require no attention except to be occasionally supplied with sulphate of copper crystals, and to have the sulphate of zinc that creeps up over their edges wiped away with a cloth.

At present our battery is tested very frequently, generally once in four or five days. The electromotive force and the internal resistance of each cell is determined. We have now had the greater number of the eighty cells in action for three months, and some of them for five or six months. During all that time they have been most satisfactory, the electromotive force of them having remained perfectly constant.

We test them by means of the reflecting electrometer, or the tangent galvanometer.

J. T. BOTTOMLEY

(*To be continued.*)

## NOTES

AFTER we went to press last week, a most cheering telegram was received in this country respecting the fate of Dr. Livingstone, as follows:—' Aden, May 1, 1872.—The *Abydos* has returned from Zanzibar. She brings news that Dr. Livingstone is safe with Stanley. The news is brought by natives." It may fairly be hoped that still more authentic intelligence will shortly be received respecting the fate of the great traveller, with respect to whom such anxiety has been manifested in this country. Another despatch speaks also of the destruction of a large portion of the town of Zanzibar by a terrible hurricane on April 15.

THE eruption of Vesuvius, respecting which we gave such details as were accessible last week, appears to be over. Whether any scientific results have been obtained by any observers besides Palmieri it is too early yet to know. We hope it may be so, and shall return to the subject as soon as the authentic accounts have been collated.

THE Annual Visitation of the Board of Visitors to Greenwich Observatory will take place on Saturday, June 1st.

THE President, Vice-President, and Council of the Pharmaceutical Society of Great Britain will hold a *conversazione* at the South Kensington Museum on Wednesday evening next, May 15.

AT a meeting of Convocation at Oxford last week, it was carried that in all the schools, except that of theology, examiners might be appointed who were not members of the University. The liberal change which had already been granted for the Natural Science School will do much to widen the general course of reading at that University, and to prevent the studies pursued there partaking too much of any narrow or special character.

MR. CHARLES TOMLINSON, F.R.S., lectures this evening at the London Institution, Finsbury Circus, on Solution and Supersaturation.

AT the Annual Meeting of the Literary and Philosophical Society of Manchester, held on the 30th ult., the following officers were elected for the ensuing year:—President, Mr. E. W. Binney, F.R.S., F.G.S.; Vice-Presidents, Dr. Jas. P. Joule, F.R.S., Dr. E. Schunck, Dr. Robert Angus Smith, F.R.S., and the Rev. W. Gaskell; Secretaries, Prof. H. E. Roscoe, F.R.S., Mr. J. Baxendell. As members of the Council, Mr. Peter Spence, Mr. W. L. Dickenson, Mr. H. Wilde, Mr. R. D. Derbyshire, Prof. Osborne Reynolds, Mr. W. Boyd Dawkins, F.R.S., Prof. Balfour Stewart, F.R.S. Few local societies can boast such a distinguished list of names as the above.

TWO Scholarships of the annual value of 30*l.* and 20*l.* respectively, tenable for two years, have been founded by the Governors of the Middlesex Hospital, for the encouragement of the study of medicine and surgery, in memory of the late Francis Broderip, a munificent benefactor to the hospital. These scholarships will be open to competition, at the end of each winter session, amongst the general students of the hospital who shall have completed their third year of study at the Medical College. The successful candidates will be required to attend and work at the hospital for a fourth year, during which period they will be eligible for the various resident appointments.

TWO Scholarships, of the annual value of 25*l.* and 20*l.* respectively, will be offered for competition at Middlesex Hospital at the commencement of the Winter Session 1872-73. Each scholarship is tenable for two years, provided the scholar conducts himself satisfactorily. These scholarships are open to all gentlemen who commence their medical studies in October 1872. Successful candidates will be required to become general students of the College. The examination will take place on September 27 and following days, and the result will be declared on October 5. The following are the subjects for examination:—Latin, Greek, French or German, Mathematics, Natural Philosophy, Chemistry, Botany, Zoology. Candidates will be examined in any three of the above subjects they may select; but only one Modern Language and two out of the last three subjects are permitted. An equal number of marks will be given to each subject, and candidates will be expected to attain a certain standard of proficiency in the subjects they select. Candidates must send in their names in writing, addressed to the Dean, at the Middlesex Hospital, stating the subjects which they elect for their examination, on or before September 24.

WE referred recently to Tilghman's ingenious process for cutting hard substances by means of a jet of sand. The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the mechanic arts, to whom the process was referred for examination, report that they have seen the operation, and that the invention seems capable of extensive use in the arts. Some of the products of the invention appear to present new and valuable features. Glass ornamented by this process can only be compared with that etched by powerful acids, yet the entire absence of all undercutting, no matter how deeply the glass is cut, renders it superior. The great merit of the invention consists in its extended utility. By means of this sand-blast effects have been produced which would be hard to imitate by any other known mechanical process, and with an ease and precision truly remarkable. They consider the invention original and of the highest utility, and deem it worthy of any mark of approbation it may be thought fit to bestow upon its originator. They therefore recommend the bestowal on the inventor of the Elliott Cresson medal of the Franklin Institute, in accordance with the rules governing such award.

PRIZES to the amount of 25*l*. are offered by the proprietors of the *Gardeners' Magazine* for dinner-table decorations in fruit and flowers, or flowers only, arranged for effect in artificial light. The competition is to take place in connection with the Royal Horticultural Society's Exhibition in Birmingham, in June.

PROF. HULL, head of the Geological Survey of Ireland, has in the press a work designed to render practical service to builders and architects by information about the varieties of stone and their respective advantages for building purposes. "In arranging the matter treated in this work," says Prof. Hull, "I have not followed any very definite order, but rather that which the subject seemed to indicate." Regretting the incorrect nomenclature which is employed in the architectural classification of natural building materials, and yet feeling that the adoption of the mineral basis of rocks as the principle of arrangement would render his book less useful for reference by architects, the author has followed the plan drawn out on his fourth page. "Commencing with the noblest of all rocks, granite, I have been naturally led onwards to the allied rocks, such as syenite, porphyry, and from those to other plutonic or volcanic rocks. After these the metamorphic serpentines and marbles form a transition series through the simpler and rarer ornamental stones into those adapted for building, and of aqueous formation." The work will be published by Messrs. Macmillan and Co.

OUR readers will be glad to learn that Dr. Bastian's "Beginnings of Life" will be published shortly after Whitsuntide. This book will be a complete exposition of those views of its author upon vital phenomena, and the conditions of their appearances, which have already excited so much interest and discussion.

THE Rugby Council for Promoting the Education of Women has just published a very useful Calendar of women holding University certificates and engaged in teaching. It contains also all the needful information for those intending to try for the examinations for women and girls conducted by the Universities of Oxford, Cambridge, London, Dublin, Edinburgh, Durham, and the Queen's University for Ireland, and will thus be of essential aid, not only to these, but also to those who are seeking the services of women who have shown themselves capable of obtaining the highest educational honours as yet open to them. It may be obtained of Mrs. F. E. Kitchener, Rugby.

THE Report of the Rugby School Natural History Society for 1871 lies before us. The preface refers with modest pride to several subjects of congratulation by the Society:—nearly all the published papers, some of them of considerable merit, are written by actual members of the school; a meteorological and astronomical section was begun in 1871, in consequence of the establishment of the Temple Observatory, and has been heartily carried out by those members of the school who were competent to serve; a large entomological section is springing up; the members of the Society have doubled during the year; and during the present spring each section has begun fortnightly meetings, from which all but real workers are to be excluded. Every year shows more and more the important place which the Natural History Societies of our public schools are taking in the scientific education of the country.

THE Report of the Marlborough College Natural History Society, now eight years old, for the half-year ending Christmas, 1871, contains no paper bearing directly on the natural history of the district. That good local work is being done by members of the Society is, however, evidenced by the excellent list of entomological notices appended. We cannot unite with the sentence in the Preface that "it is an almost utter impossibility to get any original matter from beginners, and it would be unreasonable to expect any." It ought to be the special aim of school Natural History Societies to cultivate original work rather than mere collecting; the opportunities for it, even for beginners, are endless; and there is no over-estimating the value to the observer of the least morsel of such original work. The papers printed in this Report are excellent in their way; Mr. Babington's on "The Malay Archipelago and its Inhabitants," is a model of what such a paper should be. The Report is illustrated by an admirable plate of *Clavaria fusiformis*, drawn by Mr. F. C. Hulme. We would venture to suggest to the Committee the propriety of excluding in future from a published report personal matters, which, though of great importance to the Society itself, do not interest the outside public.

THE Royal Cornwall Polytechnic Society has published its thirty-ninth Annual Report for 1871. Among the more important lectures and papers contained in it may be mentioned "On the Comparative Health and Longevity of Cornish Miners," containing a large number of very valuable statistics, by Mr. R. Blee; and the "Meteorology of West Cornwall and the Scilly Islands for 1871," by Mr. W. P. Dymond, besides descriptions of a number of mechanical inventions and applications especially valuable to those engaged in mining operations.

THE first excursion of the Geologists' Association to Watford took place on April 13, under the guidance of Messrs. W. Whitaker and J. Hopkinson. The first section visited was a fine one of the Glacial Drift now exposed by the side of the railway near Watford to a depth of 30 feet. The drift is the "Middle Glacial," and consists of sand and sub-angular gravels with pebbles of various rocks, some of which are evidently from very distant localities. After passing through Cassiobury Park, the party proceeded to Bushey Heath, at which place the "Basement Bed" of the London Clay is exposed, with the upper portion of the Woolwich and Reading series. This section was described by Mr. Whitaker, as was also one at Bushey Heath Kiln, where the Woolwich and Reading series is again seen. The formation is, however, represented by beds of sand at the former place, and by pebble beds at the latter. The next excursion was to Hampstead on April 27, directed by Messrs. J. R. Pattison and C. Evans. The party assembled at the Swiss Cottage station, and crossed the fields to Hampstead; but before the village was reached the structure of the hill was described, and the indications of the junction of the London Clay and the Bagshot Sands were observed. The summit of the hill consists of an outlier of the Bagshot Sands overlying the uppermost sandy beds of the London Clay, containing *Pectunculus decussatus* and *Voluta nodosa*. The Conduit spring was visited, and the line of junction of the two formations, indicated by springs and pools, was followed as far as the Vale of Health pond. The highest point of the Heath was then soon gained, and here the physiography of the district was pointed out. After passing through the West Heath valley, in which a thin bed of water-bearing sand above the clay has produced a swamp, the party visited the residence of Mr. C. Evans, and inspected that gentleman's fine collection of Tertiary fossils.

The new School of Science and the new Museum and Art Gallery at the rear of the Hartley Hall, Southampton, are fast approaching completion. There are two class rooms of about 20ft. by 16ft. 6in. and 16ft. high, and a large drawing-class room, 32ft. by 16ft. 6in. and 16ft. high. In the Art Gallery and Museum are two large rooms, 42ft. by 20ft., and about 18ft. high, lighted from the roof and connected with the Science School and the Art School.

A free Museum has lately been opened at Nottingham in Wheeler-Gate. The greater portion of the objects of interest which are in the museum, now the property of the town, originally belonged to the Nottingham Naturalists' Society, and a considerable number of valuable objects were added from time to time until the museum assumed its present dimensions.

According to the Stockholm *Aftonbladet* an important discovery has been made in Sweden. An extensive coal-bed of remarkable depth and excellent quality has been struck near Raus, in Schonen. An enterprising company formed some time ago was encouraged by promising geological indications to institute borings, but the first results were hardly satisfactory. At a depth of 566ft. eleven strata of coal had indeed been pierced, but none of these exceeded in depth 1¼ft. Five feet farther down, however, a bed was struck with a thickness of 8¾ft. The borings have been continued, and are believed to prove satisfactorily the existence of an extensive coal-bed.

A most violent cyclone occurred at Madras on May 1. Many vessels were driven on shore, and completely wrecked. The pier has been again breached, and great damage done to the city and suburbs. On Friday, the 3rd, the storm was slightly abating.

At a recent sitting of the French Academy a letter was read from the French Consular agent at Mostar on the earthquakes felt throughout the Herzegovina during the months of February and March last. The first was felt on the 6th of February, two days after the great aurora borealis. Other oscillations followed on the 7th and 8th, apparently in a N.W. and S.E. direction On the 13th a longer shock was experienced, followed by a loud rumbling sound like distant cannon. On the 25th and 27th stronger shocks, accompanied by noise, were felt, making about forty since the 6th. On March 2 and 3 the manifestations increased in intensity; but neither Ragusa nor Serajevo, so subject to earthquakes, appear to have been at all affected all the time.

Some time in the summer of 1871 it was stated that Mr. Octave Pavé, a young Louisiana Frenchman, had started toward the North Pole by way of Siberia and Wrangell's Land, and that, in the absence of news from him, the assistance of the Siberian Government had been invoked, in consequence of grave fears for his safety. It now appears that he has not yet started on his mission, but is to sail from San Francisco in May for Kamschatka, where he will take in supplies, and proceed to Cape Yakan, on the north-east coast of Siberia. Here the vessel is to be abandoned, and a further exploration attempted on an India-rubber raft, composed of four rubber cylinders fastened together on the decks by wooden slats, to which the masts and rigging are attached. It is intended to head, after leaving Cape Yakan, for Wrangell's Land, a large island discovered by Captain Long in 1867. This being reached, the island is to be crossed on sledges; and if an open sea occur beyond, he is to take the raft again, and endeavour to sail to Greenland or Spitzbergen. The entire enterprise is conducted at the expense of the traveller; and however hazardous or chimerical the plan may be, we cannot but wish him success in his movements.

## HISTORY OF THE NAMES CAMBRIAN AND SILURIAN IN GEOLOGY[*]

(*Continued from page* 17)

What then was the value and the significance of the Silurian sections of Murchison, when examined in the light of the results of the Government surveyors? The Llandeilo rocks, having throughout the characteristic *Orthis* so much insisted upon by Murchison, were shown to be the base of a great conformable series, and to the eastward, in Shropshire, to rest on the upturned edges of the Longmynd rocks; while westward, near Bala, they overlie unconformably the Lingula-flags, and in the island of Anglesea repose directly upon the ancient crystalline schists. According to the author of the "Silurian System," there existed beneath the base of the Llandeilo formation a great conformable series of slaty rocks into which this formation passed, and from which it could not be distinguished either zoologically, stratigraphically, or lithologically. The sequence, determined from what were considered typical sections in the valley of the Towey in Caermarthenshire, as given by Murchison, for several years both before and after the publication of his work, was as follows:—1. Cambrian; 2. Llandeilo flags; 3. Caradoc sandstone; 4. Wenlock and Ludlow beds; 5. Old Red sandstone; the order being from north-west to south-east. What then were these fossiliferous Cambrian beds underlying the Llandeilo and indistinguishable from it? Sedgwick, with the aid of the Government surveyors, has answered the question in a manner which is well illustrated in his ideal section across the valley of the Towey. The whole of the Bala or Caradoc group rises in undulations to the north-west, while the Llandeilo flags at its base appear on an anticlinal in the valley, and are succeeded to the south-east by a portion of the Bala. The great mass of this group on the south-east side of the anticlinal is however concealed by the overlapping May Hill sandstone—the base of the unconformable upper series which includes the Wenlock and Ludlow beds. (Philos. Mag. IV. viii. 488.) The section to the south-east, commencing from the Llandeilo flags on the anticlinal, was made by Murchison the Silurian system, while the great mass of strata on the north-west side of the Llandeilo (which is the complete representative of the Caradoc or Bala beds, partially concealed on the south-west side) was supposed by him to lie beneath the Llandeilo, and was called Cambrian (the Upper Cambrian of Sedgwick). These rocks, with the Llandeilo at their base, were in fact identical with the Bala group studied by the latter in North Wales, and are now clearly traced through all the intermediate distance. This is admitted by Murchison, who says:—"The first rectification of this erroneous view was made in 1842 by Prof. Ramsay, who observed that instead of being succeeded by lower rocks to the north and west, the Llandeilo flags folded over in those directions, and passed under superior strata, charged with fossils which Mr. Salter recognised as well-known types of the Caradoc or Bala beds." ("Siluria," 4th ed., p. 57, foot-note.)

The true order of succession in South Wales was in fact:—1. Llandeilo; 2. Cambrian (=Caradoc or Bala); 3. Wenlock and Ludlow; 4. Old Red sandstone; the Caradoc or Bala beds being repeated on the two sides of the anticlinal, but in great part concealed on the south-east side by the overlapping May Hill or Upper Llandovery rocks. These latter, as has been shown, form the true base of the upper series which, in the Silurian sections, was represented by the Wenlock and Ludlow. Murchison had, by a strange oversight, completely inverted the order of his lower series, and turned the inferior members upside down. In fact, the Llandeilo flags, instead of being, as he had maintained, superior to the Cambrian (Caradoc or Bala) beds, were really inferior to them, and were only made Silurian by a great mistake. The Caradoc, under different names, was thus made to do duty at two horizons in the Silurian system, both below and above the Llandeilo flags. Nor was this all; for by another error, as we have seen, the Caradoc in the latter position was made to include the Pentamerus beds of the unconformably overlying series. Thus it clearly appears that, with the exception of the relations of the Wenlock and Ludlow beds to each other and to the overlying Old Red sandstone, which were correctly determined, the Silurian system of Murchison was altogether incorrect, and was moreover based upon a series of stratigraphical mistakes, which are scarcely paralleled in the history of geological investigation.

It was thus that the Lower Silurian was imposed on the scientific world; and we may as well ask with Sedgwick, whether

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[*] Reprinted from advance sheets of the *Canadian Naturalist*.